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Otto Lilienthal and Octave Chanute: Pioneers of Gliding

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The aeronautical pioneers who built and flew hang gliders during the closing years of the 19th century laid the foundation for the design of the first successful flying machines. Francis H. Wenham, John J. Montgomery, Louis Mouillard and Percy S. Pilcher were all members of this group of enthusiasts. Otto Lilienthal and Octave Chanute, however, were the recognized leaders of the movement to develop a stable glider as the first step toward powered flight.

OTTO LILIENTHAL (1848-1896)

Otto Lilienthal. **A-39013**

Otto Lilienthal was born in the Pomeranian village of Ankalm on May 24, 1848. He and his younger brother Gustav first became interested in aeronautics as a result of their observations of birds in flight. As early as 1862 the two boys constructed an unsuccessful ornithopter, or flapping-wing machine. By 1868 they had built two more such craft, both of which featured plane, or flat-wing surfaces.

Lilienthal received a solid technical education and was employed by a number of German firms prior to 1880 when he founded his own machine shop specializing in the production of marine signal devices and lightweight steam engines. In 1871 he began serious research in aeronautics with a series of experiments designed to probe the physical principles which enabled birds to fly, and which could also serve as a basis for the design of a successful airplane. The results of these tests, including important studies of the lift created by a curved surface in a moving stream of air, were published in 1889 under the title *Der Vogelflug als Grundlage der Fliegekunst* ("Birdflight as the Basis of Aviation"). This volume was perhaps the most important book published during the 19th century on the subject of aviation. It heavily influenced the Wright brothers and other experimenters who were becoming interested in the problems of flight.

Lilienthal was not satisfied to restrict himself to the exploration of aerodynamic theory, however. In 1891 he began work on a series of gliders which he hoped would demonstrate the practical applicability of the principles outlined in his book. After two failures, he constructed his first successful glider in 1893. Like all of his subsequent designs, this third craft was a hang glider in which the pilot was suspended between the wings by bars which passed beneath his arms.

The movements of the operator's legs, which hung beneath the craft, provided the only means of control. Lilienthal had speculated on more sophisticated methods of guiding his machines, including simple wing warping, the use of a moveable rudder, wing tip air brakes, and a tail surface which could be raised by means of a strap attached to the pilot's head. He was unable to apply any of these mechanisms successfully, however, and continued to rely on the shifting of body weight as the primary system of control.

Otto Lilienthal constructed a total of 18 glider types between 1891 and 1896. The most successful of these was his model No. 11, built in 1894. A small number of these machines were reproduced for sale in Germany and abroad. At least two of these gliders, one of which is now in the collections of the National Air and Space Museum, were purchased by Americans.

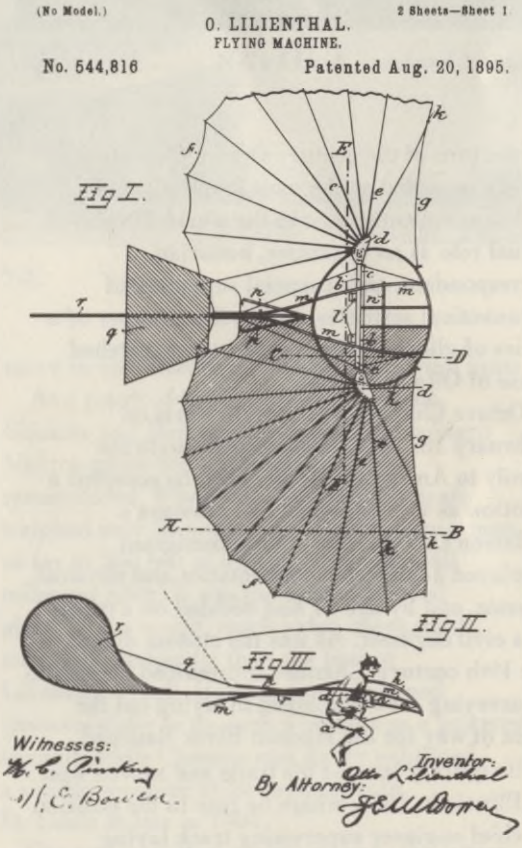
Lilienthal departed from the preferred fixed wing monoplane configuration on several occasions. One of his gliders, for example, was built with folding wings for easy storage. He also produced a number of biplanes which he believed might be easier to control in gusty winds.

Lilienthal was, of course, interested in accomplishing the ultimate goal of powered heavier-than-air flight, and built two unsuccessful powered aircraft. The first, No. 16, was constructed in 1893. A small carbonic acid gas engine was provided to drive a series of "flappers" intended to propel the craft forward. This machine was tested as a glider with the engine in place, but no attempt was made with the engine running. Lilienthal had completed a second motorized glider at the time of his death. Like the earlier craft, this machine was to be propelled by flapping wing tips driven by a small carbonic acid gas power plant. His rejection of the screw propeller in favor of the ornithopter technique, as well as his inability to develop an efficient control system, doomed these attempts at powered flight to failure.

During the course of more than 2,000 glides completed by the summer of 1896, Lilienthal suffered only one serious accident. On this occasion the *Prellbügel*, a protective wooden hoop which passed in front of the pilot's chest, had absorbed most of the impact and prevented serious injury.

On August 9, 1896 Lilienthal was flying one of his standard monoplane gliders, but without the protective shock absorber. Contrary to rumors which circulated at the time, he was not testing a new control system. Gliding down the slope in a normal fashion the machine encountered a sudden gust of wind which carried it to an altitude of about 50 feet. Evidently shaken by the rapid climb, the operator was unable to depress the leading edge of the wing. The glider stalled, then fell off on the right wing and crashed. Lilienthal died of a broken back in a Berlin hospital the next day.

While he did not achieve success with a powered craft, the German master had accomplished a great deal. He was the first of the flying machine experimenters whose exploits were closely followed by the newspapers and magazines of the period. The photographs showing Lilienthal gliding effortlessly through the air convinced the general public that the airplane was no longer a futile dream. In addition, his thoughtful scientific approach to the problems of flight and the memory of his personal courage would serve as an inspiration for all who followed.


(No Model.) 2 Sheets—Sheet 1

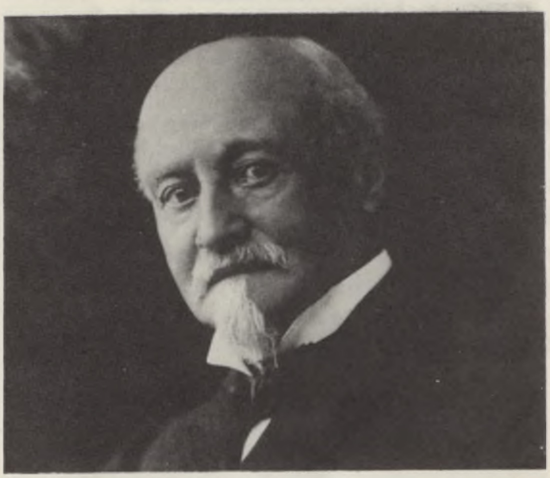
O. LILIENTHAL.
FLYING MACHINE.

No. 544,816 Patented Aug. 20, 1895.

Patent sketch of Lilienthal flying machine.
74-8011

AEU3944

OCTAVE CHANUTE (1832-1910)



Octave Chanute. **A-21147-B**

At the turn of the century Octave Chanute was widely regarded as the most knowledgeable aeronautical enthusiast in the world. He played a dual role as an organizer, historian, correspondent, and financial supporter of aeronautical activities, and as the designer of a series of gliders whose performance matched those of Otto Lilienthal.

Octave Chanute was born in Paris on February 18, 1832. His father brought the family to America in 1838, when he accepted a position as vice-president of Louisiana's Jefferson College. The young immigrant displayed a talent for mathematics and physical science, and by age 17 had decided on a career as a civil engineer. As was the custom during the 19th century, Chanute apprenticed himself to a surveying crew employed in laying out the right of way for the Hudson River Railroad.

He quickly learned his trade and moved west to Illinois in 1856, where he rose to the position of chief engineer supervising track laying operations for several railroads. During this period he also entered and won design competitions for a number of major bridges and architectural projects. His work on the Kansas City Bridge, the first span over the Missouri River at St. Charles, Missouri; the Kinzua Creek bridge in Western Pennsylvania, and Chicago's Union Stockyards marked him as one of the most active and successful civil engineers in America.

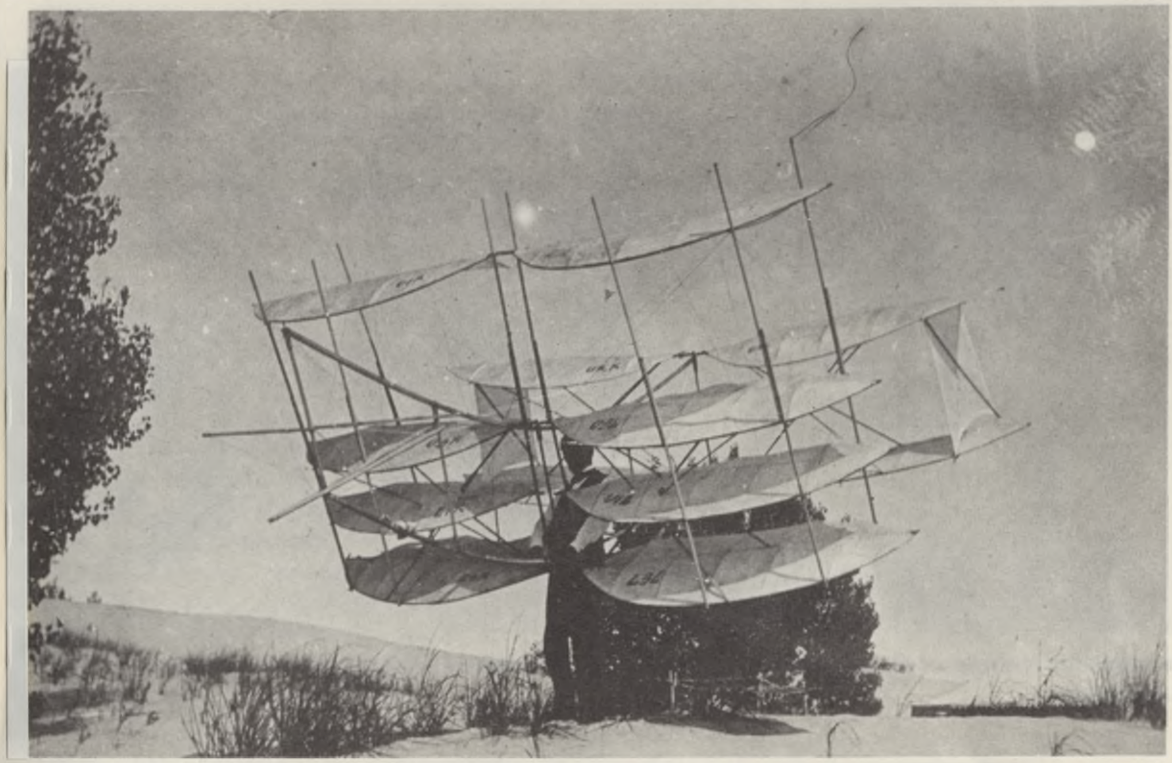
Chanute capped his professional career when he was named chief engineer of the reorganized Erie Railroad in 1873. He retired to Chicago in 1890, where he established himself as an engineering consultant specializing in wood preservation.

Octave Chanute became interested in aviation about 1875, when he first began to apply his professional knowledge of stress analysis, trussing, and materials research to problems in aerodynamics. By 1890 he had given a number of major speeches and written extensively on the subject of flight. He was perhaps best known, however, for the 27 articles which he published in the *Railroad and Engineering* Journal under the title "Progress in Flying Machines." Reprinted as a book in 1894, these articles remain the finest exposition of aeronautical history and theory as understood at that time.

For many years Chanute functioned as a clearing house for information on flying machine developments around the world. He maintained a voluminous correspondence with such leading figures as Otto Lilienthal, Hiram Maxim, F. H. Wenham, Lawrence Hargrave and others. In addition, he offered direct financial assistance to impoverished but gifted aeronautical experimenters like Louis Mouillard, a French emigré living in Cairo.

Chanute was particularly influential in organizing the International Conference on Aerial Navigation in Chicago in 1893. This meeting, which featured papers by the world's leading authorities on aerodynamics, did much to convince the general public that scientists and engineers were at last taking a serious interest in flight.

Chanute had long advised interested persons that the shortest route to the development of a successful airplane was to build and fly man-carrying gliders. In 1896 he established a camp on the shores of Lake Michigan near Miller, Indiana, where he could test his own gliders. Several disciples,



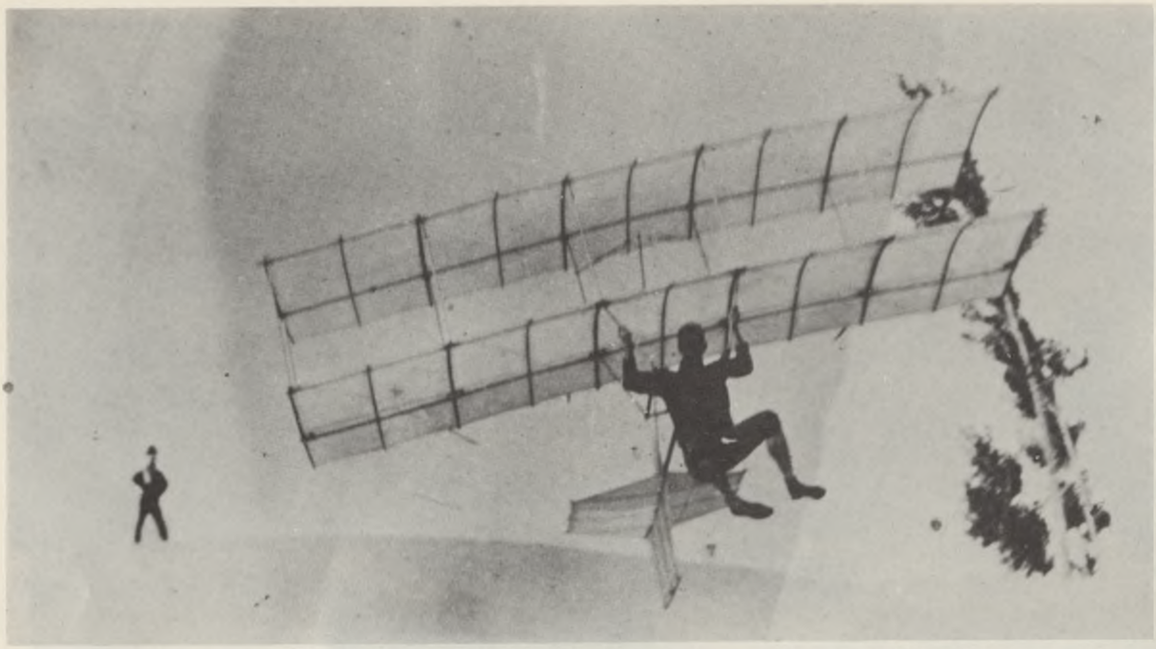
Octave Chanute in multiplane hang glider. **A-49477-L**

including Augustus M. Herring, William Avery, Paul Butusov, and Dr. James Ricketts, a Chicago physician "with a slack practice and a taste for aeronautics," accompanied him. Glides with a Lilienthal machine contructed by Herring and a very large craft designed and built by Butusov proved unsuccessful, and the little group soon concentrated their attention on a multiwing glider of Chanute's known as the "Katydid." This original craft was designed so that the number of wings used during a particular flight could vary from three to six. Moreover, the upper tiers of wings could be moved forward or backward in an effort to control the movement of the center of pressure on the surface.

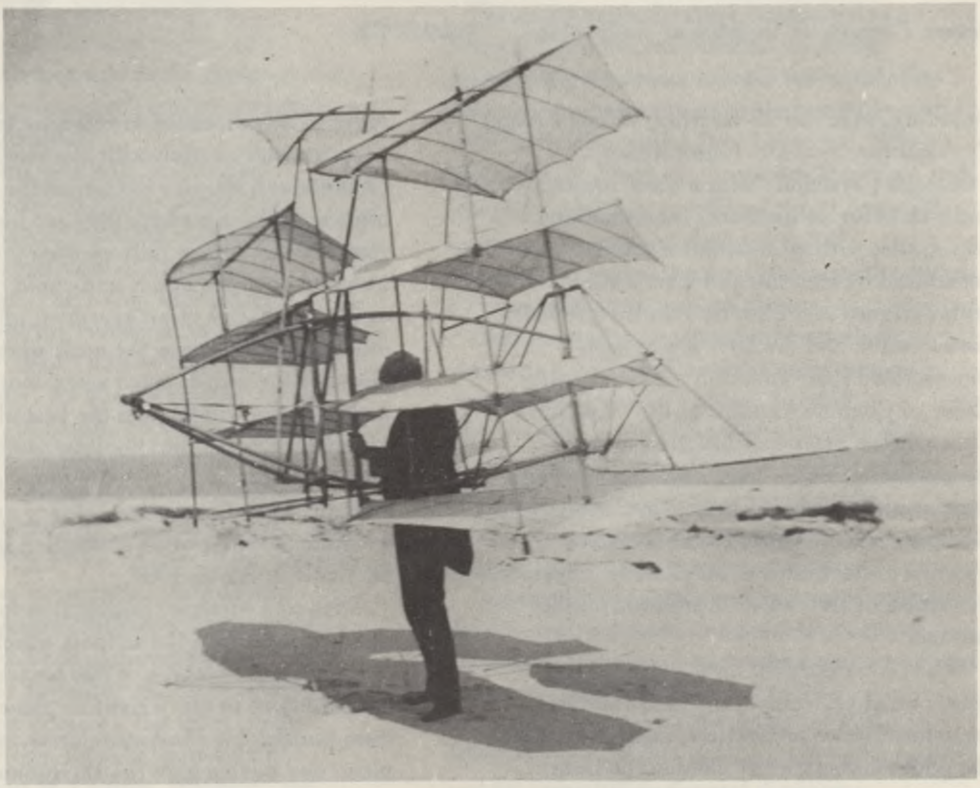
While Chaute relied on the shift of the pilot's weight to control the machine, he introduced some innovations intended to make the glider automatically stable. The most important of these was a cruciform tail free to move in any direction in response to wind gusts.

As a result of trials with this machine, Chanute and Herring developed the standard biplane glider for which they are best remembered. When fully evolved this craft weighed only 23 pounds and could carry a man as far as 360 feet at air speeds of up to 40 miles per hour. It was the most advanced glider in the world, much safer, more stable, and easier to handle than the best of Lilienthal's craft. Herring later attemped unsuccessfully to fly such a biplane as a powered aircraft, while Chanute and Avery exhibited a similar machine at an exposition in St. Louis as late as 1904.

Chanute's greatest contribution to the future of aeronautics was the support which he gave to the Wright brothers. While his technical contributions to the Wright airplane were limited, his constant interest, encouragement, and advice gave the Daytonians the confidence which was so important in the final success of December 17, 1903.



Augustus M. Herring in Octave Chanute's 1896-97 glider (Dune Park near Miller, Indiana).
A-48095-L



Octave Chanute's 1896 multiplane glider "Katydid." **A-4387-D**

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Cover photograph:
Otto Lilienthal gliding with biplane from a hill at Gr. Lichterfeld (suburb of Berlin, West Germany). **73-3022**

A price list for the photographs shown in this booklet may be obtained from the National Air and Space Museum Library, Smithsonian Institution, Washington, D.C. 20560.

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